Chapter 7 - Fire Protection Design Standards

7.1 Introduction

Sandia National Laboratories (SNL) is committed to protecting workers, the public, the environment, and property from fire and its related hazards through the execution of a comprehensive Corporate Fire Protection Program. SNL shall comply with the fire protection requirements as delineated to the Contractor via DOE Order 420.1B Contractor Requirements Document (CRD) and 10 CFR 851 and the referenced codes and standards therein. Other requirements may be added by the SSO Manager as the designated Authority Having Jurisdiction (AHJ) as defined in DOE O 420.1B and by the Corporate Fire Marshall. DOE implementation guidance and technical standards referenced in DOE O 420.1B are not mandatory but must be considered in conjunction with specific requirements.

The concepts of Highly Protected Risk and defense-in-depth will be applied in a risked-based approach to comply with contractual requirements, to achieve DOE fire safety objectives and mission success, and to drive continuous improvement. SNL will meet or exceed the minimum requirements established by the National Fire Protection Association (NFPA), model building codes, and DOE Order 420.1B requirements. Alternate methods that satisfy the requirements must be justified to ensure that an adequate level of safety commensurate with identified hazards is achieved, and the method shall be approved by the Authority Having Jurisdiction (AHJ) prior to its implementation.

New Construction and Modifications

Ensure all new construction complies with the national consensus industry standards and the model building codes applicable for the state or region supplemented in a graded manner per Corporate Procedure CG100.3.3 Enforce Building Codes. All facility modifications shall be constructed to meet codes and standards in effect when the design criteria are approved, otherwise known as the Code of Record (COR). Provisions of subsequent editions of codes or standards (promulgated after the COR) will be met to the extent that they are explicitly stated to be applicable to existing facilities. Other provisions of updated codes and standards must be applied to existing facilities when a construction modification takes place or when a potential for immediate risk to life safety or health has been identified.

Highly Protected Risk (HPR) Status

Provide a level of safety sufficient to fulfill the requirements of highly protected risk (HPR). HPR is a rating given to property that qualifies for insurance coverage by industrial insurance companies that limits their insurance underwriting to this best-protected class of risk. This level of safety is established by applying a graded approach and experience in the application of insurance industry standards to determine the appropriate HPR provisions. Refer to the FM Global Property Loss Prevention Datasheets for engineering guidelines.

Fire Hazards Analyses (FHA)

An FHA shall be developed, using a graded approach, for all hazard category 1, 2, and 3 nuclear facilities, significant new facilities (as determined by the AHJ), and facilities that represent unique fire safety risks. This includes planned facilities and significant renovations to existing facilities.

In accordance with the graded approach concept, the level of detail in the FHA is directly related to the complexity of the facility and the potential risk to the public and the facility operators.

The FHA process shall begin early in the design phase, be updated whenever significant changes occur within a fire area, and form the basis of the post-construction FHA. The FHA shall also support the conclusions of any Documented Safety Analysis (DSA) and its annual update.

Refer to SNL/NM FMOC AP-241 Integration of Documented Safety Analyses and Fire Hazards Analyses Administrative Procedure for information.

Fire Protection Design

A comprehensive fire protection design for facilities and supporting systems shall be developed, implemented, and maintained (with appropriate oversight by a qualified fire protection engineer of plans, specifications, and testing of fire protection features) to include:

- Insurance of a reliable and adequate supply of water for fire suppression.
- Noncombustible construction materials for facilities exceeding the size limitations established in DOE-STD-1066-99.
- Complete fire-rated construction and barriers, commensurate with the applicable codes and fire hazards, to isolate hazardous areas and minimize fire spread and loss potential consistent with limits as defined in DOE-STD-1066-99.
- Automatic fire extinguishing systems throughout all significant facilities and in all facilities and areas with potential for loss of safety class systems (other than fire protection systems), significant life safety hazards, unacceptable program interruption, or fire loss potential in excess of limits defined by DOE-STD-1066-99.
- Redundant fire protection systems in areas where safety class systems are vulnerable to fire damage, and no redundant safety capability exists outside of the fire area of interest or the maximum possible fire loss (MPFL) exceeds limits established by the AHJ.
- In new facilities, redundant safety class systems (other than fire protection systems) must be located in separate fire areas.

- A means (e.g., fire alarm or signaling system) to notify emergency responders and building occupants of a fire.

- Emergency egress and illumination for safe facility evacuation in the event of fire as required by applicable codes or fire hazards analysis. Life safety provisions fall within the jurisdiction of 10 CFR Part 851 and DOE O 440.1B. Refer to DOE G 440.1- 8 for additional guidance. Additional or modified exiting requirements for toxic and explosive environments should be as determined by the appropriate authorities defined within the above stated documents. In addition, for explosive environments, exits should reflect the criteria contained in the DOE Explosives Safety Manual (DOE M 440.1-1A).

- Physical access and appropriate equipment that is accessible for effective fire department intervention (e.g., interior standpipe systems in multi-story or large, complex facilities).

- A means to prevent the accidental release of significant quantities of contaminated products of combustion and fire fighting water to the environment, such as ventilation control and filter systems, and curbs and dikes. Such features would only be necessary if required by the FHA or DSA in conjunction with other facility or site environmental protection measures.

- A means to address fire and related hazards that are unique to DOE and not addressed by industry codes and standards. Mitigation features may consist of isolation, segregation, or use of special fire control systems (water mist, clean agent, or other special suppression systems) as determined by the FHA.

- Fire protection systems designed such that their inadvertent operation, inactivation, or failure of structural stability will not result in the loss of vital safety functions or inoperability of safety class systems as determined by the DSA.

7.2 Automatic Sprinklers

In some circumstances, the need for automatic sprinklers should be considered, despite the absence of explicit requirements, such as when the MPFL is
below $3 million or other limits imposed by DOE. Some examples of situations where automatic sprinkler system may be warranted are :

- facilities that contain critical or long procurement time construction items;

- a facility with high public visibility or sensitivity (as defined by the AHJ);

- electric power transformers with combustible contents that, if damaged, could result in an extended shut-down of the facilities they serve;

- facilities in which a fire could result in the accidental release of significant quantities of toxic or hazardous materials or emissions (based on engineering

analysis);

- facilities that can be protected by extending automatic fire suppression systems from an adjacent protected facility or area at a low incremental cost;
- facilities in which a fire could damage more important adjacent facilities;
- facilities used to store hard to replace or irreplaceable records;
- facilities where required for protection of human life.

Automatic sprinklers are the preferred fire protection system and are required in the following locations:

- Where required by the Building Codes,
- All structures (including temporary or relocatable) over 5,000 square feet in size,
- In all structures having a MPFL in excess of $3,000,000,
- In all structures where the MPFL will affect a vital program longer than that specified as acceptable by the DOE, and
- In all hazardous (Group H) occupancies.

Automatic fire sprinklers shall be provided throughout the building. Sprinkler system occupancy classification design density and system type shall be determined with guidance from the Fire Protection Engineering and Facilities Construction Standard Specification Section 15310.

The system shall be wet-pipe, unless otherwise specified. Design the system in accordance with Facilities Construction Standard Specification 15310, Automatic Sprinklers and Water Based Fire Protection Systems. The sprinkler system may be designed and installed by a licensed sprinkler contractor, or designed by an A/E firm with fire protection expertise and installed by a licensed contractor. The design shall be prepared by a New Mexico licensed designer in accordance with State of New Mexico requirements.

For new building design, the sprinkler piping system shall be a separate service entrance, and the riser shall contain an outside stem and yoke gate valve, an alarm check valve, plus a reduced-pressure backflow prevention (RPBFP). See Chapter 7.3, Fire Protection Backflow Preventers, for design requirements. Fire riser system and catastrophic drains to the exterior of the building shall be located such that the discharge does not normally flow onto sidewalks, parking areas, and similar areas. The intent is to prevent additional hazards from sudden discharges where people might gather, and to reduce accumulation of ice on walkways and roadways in freezing weather.

Provide a fire department connection for the building in an area accessible for the first response unit from Kirtland Air Force Base (KAFB) Fire Department. The fire department connection shall be located in close proximity to the main entrance or location of the Fire Alarm Panel, shall be approved by a New Mexico licensed designer in accordance with State of New Mexico, and shall be reviewed by SNL/NM Fire Protection Engineering. This will allow the first responding

fire department apparatus to pull up to the front of the building, check the panel and connect to the Fire Department Connection if necessary.

The fire protection designer shall indicate the entire area to be sprinklered, and those areas that do not require sprinklers in accordance with the IBC. The fire protection designer shall also indicate the following:

- Areas to be sprinklered
- Occupancy classification (Refer to Table 1.04B, Construction Standard Specification Section 15310, Automatic Sprinkler and Water Based Fire Protection Systems)
- Sprinkler type
- Design density
- RPBFP (including drainage and control valves)
- Water supply main size, location
- Water supply data
- Fire hydrant location and number
- Lead-in size location and number
- Post indicator valve(s) location and number
- Riser location
- Fire department connection location
- Fire department access
- Vehicular barriers
- Standpipes

Place the words “Fire Protection” in the title block of the drawing. Develop the drawings in accordance with Facilities Construction Standard Specification 15310, Automatic Sprinklers and Water Based Fire Protection Systems.

Provide heating for sprinkler-protected spaces in lieu of providing anti-freeze systems. In unheated areas such as vehicular airlocks, airlocks, canopied areas, etc., a dry-pipe valve system should be specified.

For modular designs, arrange sprinklers in a repetitive pattern where possible. The sprinkler layout shall be approved by a New Mexico licensed designer in accordance with State of New Mexico requirements, and reviewed by the Sandia/NM Fire Protection Engineer during Title II.

Seismic protection for automatic sprinkler systems is required for all new systems. Consult with the Sandia/NM Fire Protection Engineer regarding modifications to existing systems. The installation guidelines for seismic protection in NFPA 13 shall be used. Where an alternative method (other than NFPA 13) of providing seismic protection of a sprinkler system is to be used, only UL Listed or FM Approved material shall be permitted. The alternative method shall have a design based on a dynamic seismic analysis certified by a registered Professional Engineer (PE) in the State of New Mexico.

Where future expansion is to be considered, sprinkler protection shall also be considered. Include a key plan to scale on the drawing to clearly show this situation. The piping size for

planned expansions and additions will be established with the design of the sprinkler system for the immediate project. This guidance shall be provided in the project-specific Design Criteria.

Class I standpipes shall be installed in all structures having three levels or more above or below grade.

7.3 Fire Protection Backflow Preventers

Automatic fire sprinkler systems are provided with a cross-connection to the site potable water supply and require the installation of a backflow prevention device to protect the water supply from possible pollution and/or contamination hazards present within the fire sprinkler system.

Backflow prevention devices should be installed inside the facility. The fire sprinkler riser and backflow prevention device shall be located such that sufficient space is provided for testing and maintenance purposes (approximately 60 feet square). The fire sprinkler riser and backflow prevention device may be located in a dedicated riser room or in other suitable spaces (i.e., mechanical equipment rooms or under stairs) to reduce cost.

The A/E shall select the proper type of backflow prevention device based on the International Plumbing Code (IPC) and the guidance in this document. Standard Drawing Numbers FX5003STD, Alarm Valve, Air Gap Interior Details, and FX5004STD, Alarm Valve Piping, should be used, with the proper detail selected by the A/E for application. Reduced pressure backflow prevention devices installed inside of a facility require the installation of the Air Gap Drain Assembly to allow for diversion of catastrophic drain from backflow device in the event of its failure. Double check valve devices installed inside and outside of facilities, and reduced pressure devices installed outside of a facility do not require the air gap assemblies.

In some cases, sub-systems of automatic sprinkler systems may considered to be in the High Hazard category, while the remaining portion of the sprinkler system would fall into the Low Hazard category. For example, these sub-systems may be attached to part of a wet-pipe sprinkler system, and most commonly are the ‘anti-freeze’ and foam-water sprinkler systems. The A/E should select a reduced-pressure backflow prevention device and place at the service entrance for the entire sprinkler system, in lieu of providing one type of backflow prevention device for the sub-system and another at the service entrance.

7.4 Fire Alarm System Design

7.4.1 System Description

Fire alarm signals are sent to the proprietary supervising station located in the Building 887. This station utilizes a Digital Alarm Communicator Receiver (DACR) to receive alarms from Digital Alarm Communicator Transmitters (DACTs) located in fire alarm control panels. The DACTs communicate to the station DACR over primary/secondary dual telephone lines using Ademco Contact ID communication format. Only the fire alarm control panels specified in Construction Standard Specification Section 13852, “Intelligent Fire Alarm System,” shall be installed in Sandia facilities.

The A/E shall provide a fire alarm floor plan drawing showing the components listed in 7.4.6 and 7.4.7 to provide guidance to the designer of the fire alarm system shop drawings. The shop

drawing design shall be prepared by personnel certified, as a minimum, NICET Fire Alarm Level III and factory trained and certified for the fire alarm system equipment being installed or modified.

7.4.2 References

The current edition of the following Construction Standard Specifications shall be utilized for the design and installation of fire alarm systems.

Section 13852, Intelligent Fire Alarm System

The latest revision of the following Standard Drawings shall be utilized for the fire alarm design requirements.

E-0006STD – Standard Symbols List and General Notes
FA7001STD – Fire Alarm Wiring Diagrams
FA7002STD – Notification Appliance Wiring Diagrams

7.4.3 Design Criteria for New Installations

All new fire alarm system installations shall be an addressable fire alarm system, a design/build installation performed by a qualified fire alarm installer per the requirements in Construction Standard Specification Section 13852, “Intelligent Fire Alarm System”.

7.4.4 Design Criteria for Modifying Existing Installations

Modifications to an existing conventional fire alarm system shall be designed by the A/E per the design criteria in Construction Standard Specification, Section 13852 “Intelligent Fire Alarm System”, Part 1.09“Modification to Existing Fire Alarm Systems”.

When initiation devices are added to a conventional fire alarm system, the devices shall be divided into zones that allow emergency responders to quickly identify the location and device(s) in alarm. Devices that are located on different floors or in separate wings of a building shall not be placed on the same zone. Manual pull stations and heat detectors can share the same zone. Group smoke detectors on the same zone. Multiple duct smoke detectors can be installed on the same zone if they are installed on the same air-handling unit and in the same general area. Each water flow detection device shall have its own zone. Combine valve supervisory switches, including PIV tamper switch that is in the same general area for the same sprinkler riser on the same zone. Each control panel for miscellaneous systems shall be provided with a dedicated zone.

Modifications to the Signal Line Circuit (SLC) of an intelligent fire alarm system shall be a design/build installation performed by a qualified fire alarm installer for the fire alarm system in service. The requirements of Construction Standard Specification Section 13852, “Intelligent Fire Alarm System” apply to the design of the system modification.

Minor modifications to existing Notification Appliance Circuits (NAC), such as adding or relocating appliances, shall be designed by the A/E per Construction Standard Specification, Section 13851 13852 for intelligent fire alarm systems; and the requirements in Section 7.4.5 “Notification Appliances” of this Design Manual

7.4.5 Notification Appliances

Provide multi-tone horn and strobe notification appliances throughout the building to comply with NFPA 72 requirements. Do not install horns or bells inside enclosed stairwells.

Wiring: Notification Appliance Circuits (NAC) shall be wired as NFPA 72 Class B, Style Y. NAC cables shall be terminated only at panels or appliances; splices are not permitted.

Multi-tone Horns: The tone for electronic audible appliances is standardized as a bell setting (1560 Hz modulated @ 0.07 seconds On/Repeat) for the Sandia –NM site. Locate multi-tone horns on floor plans to provide a minimum of 15 decibels (dBA) above the ambient background noise. In addition to hallways and common areas, provide multi-tone horns inside labs and in the occupant work locations to more effectively notify building occupants. Assume that the output of the multi-tone horn is reduced by 6 dBA as the distance between the appliance and the listener is doubled. Take into consideration the acoustic properties of the materials in the listening space, such as the wall and door construction, when locating audible appliances on floor plans. Where ambient noise levels exceed 105 dBA, provide a strobe in addition to the multi-tone horn. Utilize the values in Table 7-2 for the ambient background noise levels for the different occupancies when locating audible appliances.

Table 7-1. Ambient Background Noise Levels for Different Occupancies

Location	Average Ambient Sound Level (dBA)	Minimum Sound Level (dBA) Required
Office Areas	55	70
Assembly Areas	55	70
Storage Areas	55	70
Computer Rooms	70	85
Labs	70	85
Low and High Bays	70	85
Clean Rooms	70	85
Mechanical Equipment Rooms	90	105

Strobes: Provide visual notification appliances in all common areas (e.g., restrooms, conference rooms, break areas, corridors, hallways, stairways, lobbies), open areas with calculated occupant loads of 10 or more occupants, and in locations with a high ambient sound level (e.g., mechanical equipment rooms). Locate strobes per the requirements in NFPA 72.

Emergency Responder Multi-tone Horn/Strobe: At the main entrance(s) to the building, provide a weatherproof multi-tone horn/strobe appliance on the exterior wall of the building that is readily visible to emergency responders and Security patrols for signaling when the building fire alarm system is in an ALARM condition.

NAC Power Supplies: Provide NAC power supplies through out the building to provide power for the audible/visual appliances and to reduce voltage drop on notification appliance circuits. Provide a dedicated 120 VAC, 20-amp branch circuit from the nearest power panel to power the NAC power supply. Locate the NAC power supplies in accessible locations for maintaining the panels (e.g., equipment chases, utility rooms).

Zoning: The boundaries of notification appliance circuit zones shall be coincide with building outer walls, building fire or smoke compartment boundaries, floor separations, or other fire

safety subdivision. NAC zones may contain any combination of multi-tone horns and strobes. Initially load each NAC zone with appliances that do not exceed 80 percent of the available NAC amperage to permit later addition of notification appliances to the circuit. For NAC appliances powered from the FACP, indicate on the floor plans the NAC output or zone number for each appliance (e.g., NAC1, Z-2). For NAC appliances powered from NAC power supplies, indicate on floor plans the power supply identifier and output number (e.g., PS1-4, PS2-1).

7.4.6 Drawing Requirements – Intelligent Fire Alarm System

For new intelligent fire alarm system designs, the A/E must provide fire alarm floor plans indicating the location of the following equipment:

1. Fire Alarm Control Panel
2. Fire suppression release panels
3. Air-sampling control system panels
4. HVAC control equipment/panels requiring interface with fire alarm system for equipment shutdown.
5. Smoke removal control panels requiring interface with fire alarm system for equipment activation.
6. Fire/smoke dampers requiring interface with fire alarm system.
7. Handicapped-accessible phones requiring interface with fire alarm system.
8. Fire doors requiring interface with fire alarm system to release (close) doors during an alarm event.
9. User equipment requiring interface with the fire alarm system.
10. Location of the automatic sprinkler system Post Indicator Valve.

The fire alarm installer will use these drawings to generate shop drawings for the design of a complete fire alarm design/build package.

The A/E shall provide panel schedules indicating the 120 VAC branch circuit supplying power to the FACP.

7.4.7 Drawing Requirements – Conventional Fire Alarm System

For modification to a conventional fire alarm system, provide plans indicating the location of the following equipment:

1. Fire Alarm Control Panel
2. Annunciators
3. Initiation devices
4. Notification appliances
5. NAC power supplies
6. Fire safety function equipment requiring connection to fire alarm system (e.g., magnetic door holders, HVAC fan shutdown equipment, fire/smoke dampers, elevator recall/shutdown).
7. Ancillary panels (e.g., air sampling control panels, fire suppression release panels).
8. Post Indicator Valves and other equipment located outside building connected to fire alarm system.

Revise the existing floor plans and building riser elementary wiring diagrams as required to reflect the modifications being made to the conventional fire alarm system Initiation Device Circuits (IDCs) and Notification Appliance Circuits (NACs).

Provide panel schedules indicating the 120 VAC branch circuit supplying power to the FACP and NAC power supplies.

Utilize the guidance and requirements in the Facilities CADD Standards Manual and as specified elsewhere in this Design Manual for the preparation of the following drawings to delineate the fire alarm system design.

7.4.8 Calculations

Provide amperage load and voltage drop calculations for each Notification Appliance Circuit. The amperage load for each NAC shall not exceed 80 percent or the rated load to permit later notification appliance additions to the circuit.

7.4.9 Fire Alarm Systems in Temporary Structures

New fire alarm system installations in temporary structures (e.g., mobile offices, T-buildings) with occupants shall utilize an addressable fire alarm control panel designed and installed per the requirements in this section of the Design Manual and the Construction Standard Specification Section13852,"Intelligent Fire Alarm System". For occupied temporary structures that are not physically connected to other similar structures and have an occupant load of less than ten people, provide commercial-grade 120 VAC photoelectric smoke detectors with an audible base, spaced throughout the structure according to the manufacturers recommendations, to notify occupants to evacuate the structure. If the temporary structure(s) are located in close proximity to a permanent building containing a fire alarm system, install a fire alarm system in the temporary structure(s) and connect to the building fire alarm control panel.

7.4.10 Coordination with Sandia

Contact the designated Sandia Fire Protection Engineer to obtain a fire alarm control panel schedule detailing the system configuration when modifying an existing fire alarm system..

- End of Chapter -